



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO 14 MISSION
FOOD PREPARATION UNIT LEAKAGE
ANOMALY REPORT NO. 1



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MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

August 1971

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APOLLO 14 MISSION

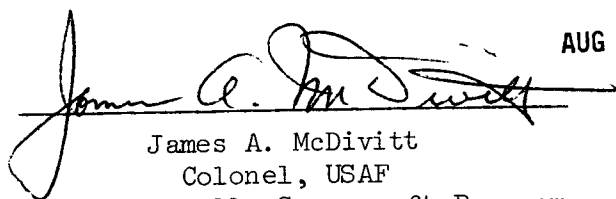
FOOD PREPARATION UNIT LEAKAGE

Anomaly Report No. 1

PREPARED BY

Mission Evaluation Team

APPROVED BY

A handwritten signature in dark ink, appearing to read "James A. McDivitt", is written over a horizontal line.

AUG 6 1971

James A. McDivitt
Colonel, USAF
Manager, Apollo Spacecraft Program

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FOOD PREPARATION UNIT LEAKAGE

STATEMENT

The crew reported that a bubble of water collected on the delivery probe of the food preparation unit after hot water was dispensed.

DISCUSSION

Hot water is dispensed through a metering valve which consists of a shuttle valve and a spring-loaded Teflon piston that rides in a metering cylinder (fig. 1). Pulling the valve handle moves the shuttle valve to the fill position. Water then enters the metering cylinder through the fill port and water pressure forces the piston back against its return spring until the metering cylinder is filled. When the piston reaches its maximum travel, the shuttle valve closes the fill port and opens the drain port. The return spring then forces the piston forward, expelling the water out the drain port.

Postflight test showed the expulsion time, i.e. time for the assembly to complete a full cycle, was longer than normal with hot water. With cold water, however, the cycle time was normal.

Inspection of the disassembled valve showed no damage or contamination. Dimensional checks showed that at 73° F, the Teflon piston (fig. 1) diameter was 1.487 inches or 0.001-inch oversize, and the cylinder diameter was 1.493 inches, the smallest allowable. At 159° F, the maximum expected flight temperature, the piston expanded to 1.495 inches and the cylinder expanded to 1.494 inches. The piston diameter was then 0.001-inch larger than the cylinder.

With the piston return spring removed, 7 pounds force was required to expel all of the water at 154° F, the nominal flight water temperature. Since the piston return spring supplies 5 pounds force with the cylinder empty and 12 pounds force with the cylinder full, the piston would stall during the expulsion part of the valve cycle and the valve would deliver a reduced quantity of water. The piston would subsequently have a tendency to creep and slowly deliver the trapped water, giving the impression of a leak.

CONCLUSION

Dimensional interference between the cylinder and piston at the hot water temperatures produced the apparent leak by causing erratic and slow stroke time of the valve assembly.

CORRECTIVE ACTION

Hot water expulsion tests will be conducted on subsequent spacecraft during checkout to insure dimensional compatibility.

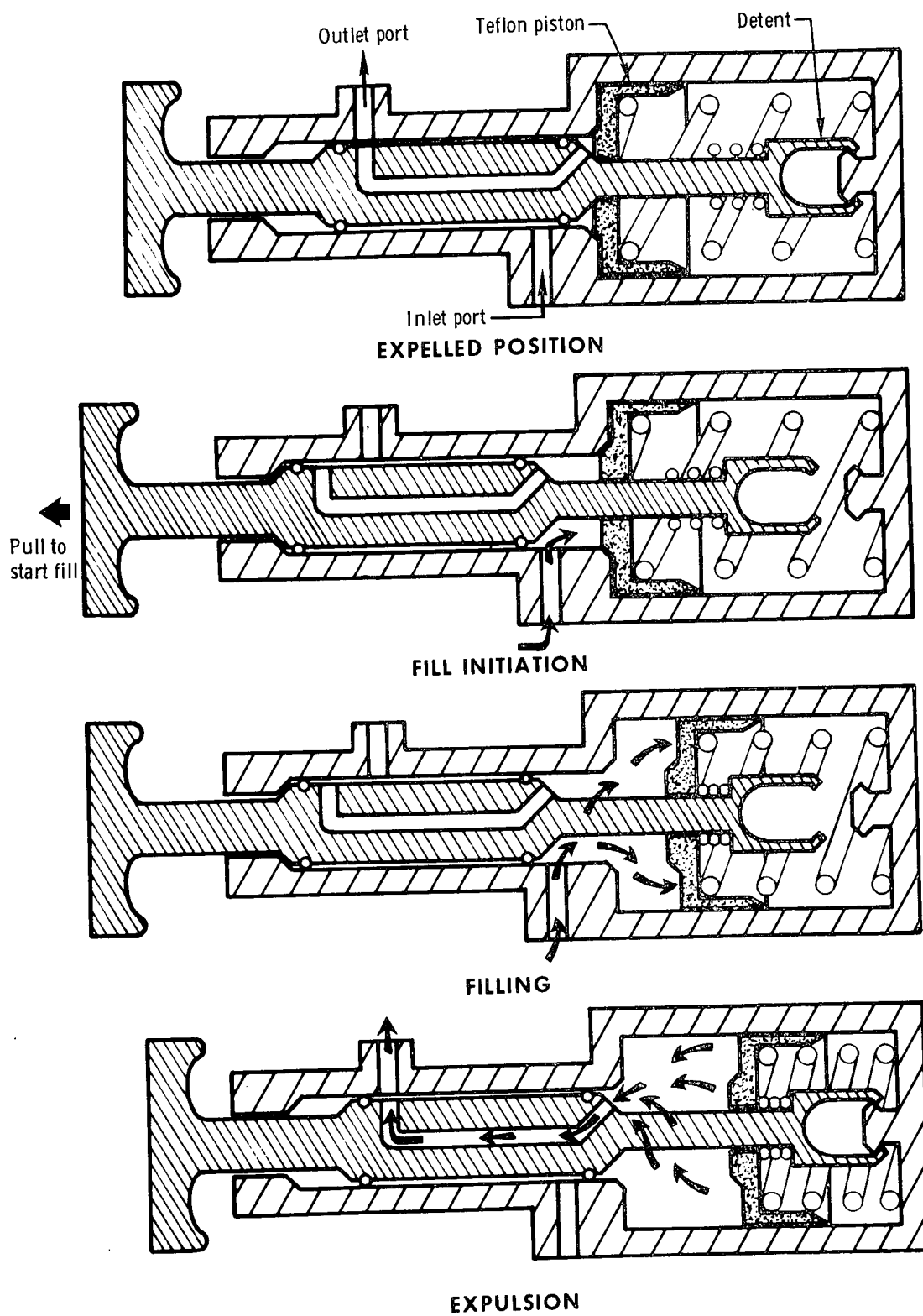


Figure 1. - Metering valve operation.